Relationship indoor air quality from urban black carbon level

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Black carbon (BC) has received particular attention around the world due to its impact on air quality and public health. Due to its fine size (size-mode 2.5 μm), large specific surface area, and irregular morphology it is easily inhaled and can affect human health, causing cardiovascular, respiratory and other diseases[1][2]. In the modern world, people spend most of their time (~90%) in indoor environments (home, offices, schools etc.) where energy-efficient buildings can create risks for indoor environmental quality and lead to a various risk of health problems[3]. Toxicological and epidemiological studies indicate an association between indoor and outdoor aerosol black carbon mass concentrations and health risks. Indoor concentrations of some pollutants have increased during recent decades due to changes in building construction standards[4]. It should be noted, that to ensure all buildings operate at net zero carbon emission by 2050, more stringent minimum requirements for the necessary energy transition have been set across the EU. This study aims to investigate influence of outdoor-to-indoor exchange on indoor levels of the BC mass concentration.

In this context, indoor and outdoor continuous real-time measurements of optical BC-related light absorption by aerosol particles were investigated in an office located at urban background environment in Vilnius, Lithuania, during the cold season (from October to December 2020). Equivalent black carbon (eBC) mass concentration was measured by an Aethalometer (Magee Scientific, model AE-31). The optical transmission of carbonaceous aerosol particles was measured sequentially at 7 wavelengths (λ= 370, 470, 520, 590, 660, 880 and 950 nm), where the eBC mass concentration was derived from the light absorption coefficient (σab) at 880 nm wavelength.

Analysis of the obtained data showed certain patterns. Hourly mean mass concentrations of eBC for weekdays and weekends show diurnal cycles, which could be explained by periodicity of traffic intensity and heating activities. Diurnal variations showed an increased contribution of outdoor for indoor eBC mass concentration during 10:00 and 12:00 AM (GMT+2), with the highest indoor eBC mass concentration of 0.097 μgm^{-3} observed, which is almost twice the indoor average. The ratio of indoor/outdoor eBC mass concentrations (I/O ratio) was below 1 during the whole observed period. The I/O ratio lower than 1 indicates that the contribution of outdoor sources is greater than that of indoor sources.

A significant influence of outdoor air quality onthe indoor air was observed. This finding is crucial for offices located next to busy roads where outdoor eBC levels are higher.

This research was funded by a grant (No. S-MIP-20-28) from the Research Council of Lithuania.

Keywords— black carbon, climate change, indoor air quality, I/O ratio.

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